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January 1999

Biology 30

Grade 12 Diploma Examination

Alberta
EDUCATION

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January 1999

Biology 30

Grade 12 Diploma Examination

Description

Time: 2.5 h. This examination was developed to be completed in 2.5 h; however, you may take an additional 0.5 h to complete the examination.

This is a **closed-book** examination consisting of

- 48 multiple-choice and 8 numerical-response questions, of equal value, worth 70% of the examination
- 2 written-response questions, of equal value, worth 30% of the examination

This exam contains sets of related questions.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

Tear-out data pages are included near the back of this booklet.

Note: *The perforated pages at the back of this booklet may be torn out and used for your rough work.* ***No marks*** *will be given for work done on the tear-out pages.*

Instructions

- You are expected to provide your own scientific calculator.
- Use only an HB pencil for the machine-scored answer sheet.
- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Read each question carefully.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- If you wish to change an answer, erase **all** traces of your first answer.
- Do not fold the answer sheet.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Now turn this page and read the detailed instructions for answering machine-scored and written-response questions.

Multiple Choice

- Decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. biology
B. physics
C. science
D. chemistry

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- If an answer is a value between 0 and 1 (e.g., 0.25), then be sure to record the 0 before the decimal place.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

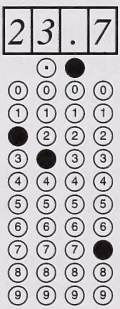
Examples

Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is _____.
(Round and record your **answer to one decimal place** in the numerical-response section on the answer sheet.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666...
= 23.7 (rounded to one decimal place)

Record 23.7 on the answer sheet →



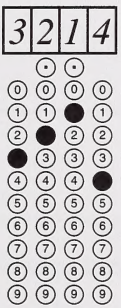
Correct-Order Question and Solution

When the following subjects are arranged in alphabetical order, the order is _____.
(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

1 physics
2 chemistry
3 biology
4 science

Answer 3214

Record 3214 on the answer sheet →



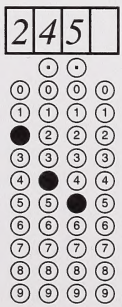
Selection Question and Solution

The birds in the following list are numbered _____.
(Record your answer **in lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

1 dog
2 sparrow
3 cat
4 robin
5 chicken

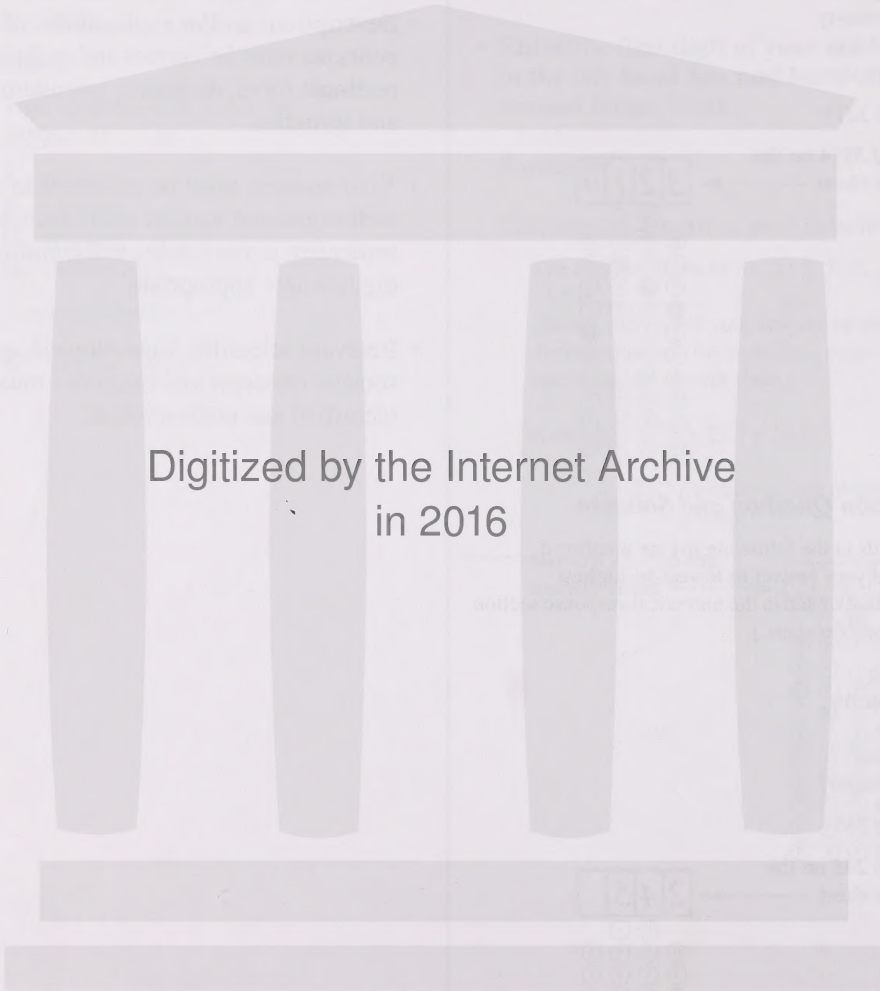
Answer 245

Record 245 on the answer sheet →



Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers must address **all** aspects of the question.
- Descriptions and/or explanations of concepts must be correct and include pertinent ideas, diagrams, calculations, and formulas.
- Your answers must be presented in a well-organized manner using complete sentences, correct units, and significant digits where appropriate.
- Relevant scientific, technological, and/or societal concepts and examples must be identified and made explicit.



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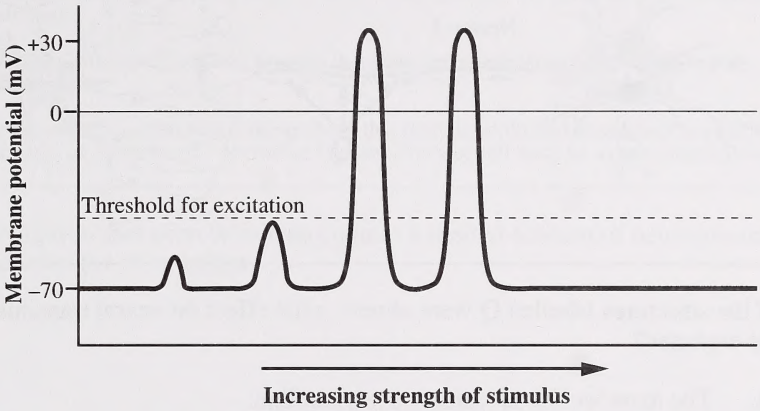
Use the following information to answer the next question.

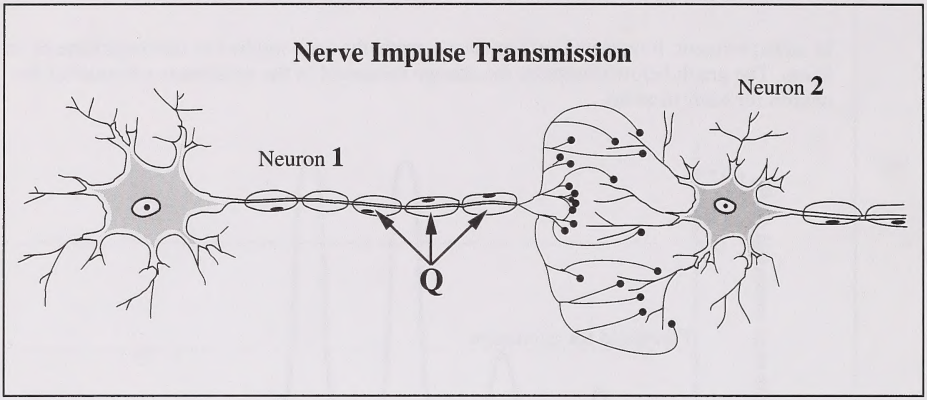
In an experiment, four stimuli of increasing strengths were applied to the membrane of an axon. The graph below illustrates the change measured in the membrane potential of the neuron for each stimulus.



1. Which of the following statements gives an accurate interpretation of the results of this experiment?

A. Most stimuli produce a nerve impulse.
B. A nerve impulse has a variety of strengths.
C. A stimulus must reach a threshold level to initiate a nerve impulse.
D. The greater the stimulus, the greater the strength of the nerve impulse produced.

Use the following information to answer the next question.



2. If the structures labelled **Q** were absent, what effect on neural transmission would be expected?

A. The axon would not release acetylcholine.
B. The axon would be not become depolarized.
C. The speed of transmission would be reduced.
D. Cholinesterase would not be secreted to deactivate acetylcholine.

Use the following information to answer the next question.

The disease myasthenia gravis causes a person to experience muscular weakness because of the failure of neuromuscular junctions to transmit signals from nerve fibres to muscle fibres. The weakness is due to a reduced sensitivity to acetylcholine, which is necessary to stimulate the muscle fibre. People suffering from this disease are often treated with neostigmine, an anticholinesterase drug, which can result in some normal muscular activity within minutes.

—from *Guyton and Hall, 1996*

3. Neostigmine is effective in treating this disease because it

A. binds with cholinesterase to form acetylcholine
B. binds with cholinesterase to increase acetycholine production
C. reduces the amount of active cholinesterase, thereby increasing the amount of acetylcholine available to stimulate muscle contraction
D. increases the amount of active cholinesterase, thereby increasing the amount of acetylcholine available to stimulate muscle contraction

Use the following information to answer the next question.

Observations About a Synapse and Synaptic Transmission

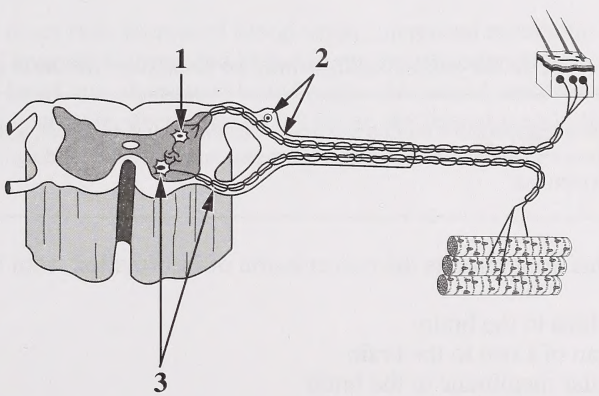
1. Only axon terminals release neurotransmitters.
2. A neurotransmitter diffuses from an axon terminal across the synapse to the dendrites or cell body.
3. Many transmissions across a synapse in a short time may cause fatigue of synaptic transmission.
4. Electron micrographs of a synapse show that there is no direct connection between the axon terminal of a presynaptic neuron and the dendrites or cell body of a postsynaptic neuron.

4. The assumption that axon terminals contain a limited amount of neurotransmitter could account for observation

A. 1
B. 2
C. 3
D. 4

Use the following information to answer the next question.

A Simple Reflex Arc

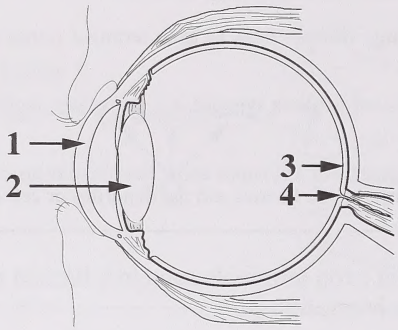


5. Structure 1 is an interneuron. Structures 2 and 3 are, **respectively**, a

A. sensory neuron and a motor neuron
B. motor neuron and a sensory neuron
C. non-myelinated neuron and a myelinated neuron
D. myelinated neuron and a non-myelinated neuron

Use the following information to answer the next question.

The Human Eye



6. An area of the eye where sensory reception of light is most acute and an area where there is no such sensory reception are labelled, **respectively**,

A. 1 and 2
B. 2 and 3
C. 3 and 4
D. 4 and 1

Use the following information to answer the next question.

Some people experience motion sickness when they travel in a boat, airplane, or automobile. Symptoms include nausea, vomiting, dizziness, and headache. A drug can be taken to reduce these symptoms.

7. Likely, this drug inhibits the transmission of information from the

A. cochlea to the brain
B. organ of Corti to the brain
C. basilar membrane to the brain
D. semicircular canals to the brain

8. During an emergency situation, the adrenal gland is stimulated to release a hormone that **directly** causes an increase in

A. insulin levels
B. blood glucose levels
C. parasympathetic stimulation
D. conversion of glucose to glycogen

9. Returning involuntary body functions to normal after a period of stress is the function of which division of the nervous system?

A. Central
B. Somatic
C. Sympathetic
D. Parasympathetic

Use the following information to answer the next question.

A tumour of the adrenal medulla is called phenochromocytoma. This tumour causes hypersecretion of epinephrine and norepinephrine, and a number of other symptoms.

10. Possible symptoms of phenochromocytoma include

A. increased heart rate, increased blood sugar, increased metabolic rate
B. decreased heart rate, increased blood sugar, increased metabolic rate
C. increased heart rate, decreased blood sugar, decreased metabolic rate
D. decreased heart rate, decreased blood sugar, decreased metabolic rate

11. A hormone that regulates glucose levels in the blood and a hormone that regulates Na^+ in the blood and, indirectly, water reabsorption by the kidneys are, **respectively**,

A. aldosterone and insulin
B. glucagon and aldosterone
C. epinephrine and glucagon
D. insulin and antidiuretic hormone

12. A condition that results in an enlargement of the thyroid gland may be caused by a diet deficient in

A. iron
B. iodine
C. sodium
D. potassium

Use the following information to answer the next question.

The following procedures and observations were used to determine the function of secretions from an animal organ suspected of being an endocrine gland.

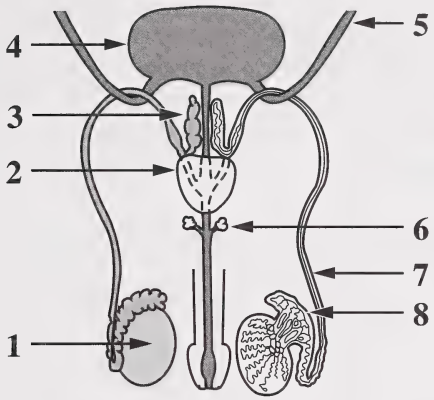
1. The suspected endocrine gland was surgically removed from the animal.
2. Symptoms in the animal were observed.
3. A chemical mixture was extracted from the suspected endocrine gland.
4. The chemical mixture was injected into the animal.
5. Symptoms in the animal were no longer observed.
6. Normal female rats injected with the chemical mixture showed accelerated body growth and increased estrogen production.

13. Based on these observations, the organ was

A. an ovary
B. the pancreas
C. an adrenal gland
D. the pituitary gland

Use the following information to answer the next question.

The Male Reproductive System and Accessory Structures



Numerical Response

1. Identify the three structures, as numbered above, that produce the fluid secretions that make up semen.

(Record your **three-digit answer in lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

Answer: _____ _____ _____

14. In humans, the temperature within the scrotum is usually

A. above body temperature
B. below body temperature
C. the same as body temperature
D. the same as room temperature

Use the following information to answer the next question.

Functions of the Four Main Reproductive Hormones in Human Females

1 Stimulation of egg development
2 Inhibition of ovulation and uterine contractions
3 Stimulation of the development of secondary sex characteristics
4 Stimulation of ovulation and formation of the corpus luteum

Numerical Response

2. Identify the major function, as numbered above, of each of the hormones given below.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

Function:	_____	_____	_____	_____
Hormone:	**FSH**	**LH**	**Estrogen**	**Progesterone**

Use the following information to answer the next question.

Reseachers have developed a birth control vaccine that would be given once a year. This vaccine is made from a fragment of HCG attached to a protein. The vaccine causes a woman to manufacture antibodies that bind to HCG molecules (when present) in the blood. The antibodies prevent HCG from functioning and thereby affect the implantation of a blastocyst (embryo).

15. The vaccine affects the permanent implantation of a blastocyst by indirectly causing

A. disintegration of the endometrium
B. increased progesterone production
C. development of new follicles in the ovary
D. inhibition of the movement of cilia in the Fallopian tubes

16. The onset of labour at the end of pregnancy is caused partly by a decreased level of

A. LH
B. FSH
C. estrogen
D. progesterone

Use the following information to answer the next three questions.

In vitro fertilization techniques can enable postmenopausal women (those who have gone through menopause) to have babies. Eggs are removed from a female donor and are fertilized in a culture dish. The early embryo is inserted into the uterus of the postmenopausal woman. The postmenopausal woman requires hormone supplements for implantation and development to succeed.

17. To increase the chance of successful implantation of an embryo produced by *in vitro* fertilization, the postmenopausal woman must receive

A. FSH and LH to promote the development of the follicle
B. FSH and LH to promote the development of the endometrium
C. estrogen and progesterone to promote the development of the follicle
D. estrogen and progesterone to promote the development of the endometrium

18. After *in vitro* fertilization, hormone supplements are administered until the fourth month of pregnancy. At this time, the hormone supplements may be discontinued because the

A. placenta produces oxytocin to inhibit uterine contraction
B. pituitary produces oxytocin to inhibit uterine contraction
C. placenta produces progesterone and estrogen to maintain the uterine lining
D. pituitary produces progesterone and estrogen to maintain the uterine lining

19. During the first trimester of a pregnancy, an extraembryonic membrane secretes HCG. In a pregnancy resulting from *in vitro* fertilization of a postmenopausal woman, HCG would **not** function normally because the

A. woman's pituitary would not respond
B. placenta would not produce FSH or LH
C. woman would not have a corpus luteum
D. placenta would not be permeable to hormones

Use the following information to answer the next two questions.

Biologists using light microscopes to study mitosis noticed that the nuclear membrane of a cell disappeared and then re-formed during the process. They could not explain this disappearance until they used electron microscopes to view mitotic cells. These observations revealed a large number of vesicles (small bubble-shaped structures bounded by membranes) that appeared in the cytoplasm during mitosis and then disappeared when mitosis was nearly complete. During mitosis, the nuclear membrane appeared to disintegrate and form these tiny vesicles. The vesicles disappeared when new nuclear membranes formed.

20. The vesicles observed with the aid of an electron microscope appeared and disappeared, **respectively**, during

A. prophase and anaphase
B. prophase and telophase
C. interphase and anaphase
D. interphase and telophase

21. During mitosis, the chromosomes

A. are located at the cell equator during prophase
B. are located at the cell equator during telophase
C. move toward the poles of the cell during anaphase
D. move toward the poles of the cell during metaphase

---

22. One aspect of meiosis that is different from mitosis is that normally by the end of meiosis

A. two diploid cells result
B. four diploid cells result
C. two haploid cells result
D. four haploid cells result

23. As cells age, there is an increase in DNA damage and a decrease in DNA repair processes. The **initial** effect is

A. a decrease in ATP synthesis
B. an increase of cancerous cells
C. the production of altered proteins
D. the production of abnormal mRNA

24. In one type of cloning, the nucleus of a cell taken from the blastula stage of an embryo is inserted into an enucleated egg cell (an egg cell with its nucleus removed). The nucleus of a cell taken from a more mature embryo would be **less suitable** for this type of cloning because such a nucleus would

A. be too large to fit inside an enucleated egg cell
B. be specialized because differentiation would have begun
C. lack some of the genes needed to develop into a total organism
D. undergo only meiosis, whereas cells of early embryos would undergo only mitosis

25. Which of the steps of human development occurs **after** chorion development?

A. Fertilization
B. Implantation
C. Cleavage (division of the zygote by mitosis)
D. Organogenesis (the formation of body organs and systems)

Use the following information to answer the next two questions.

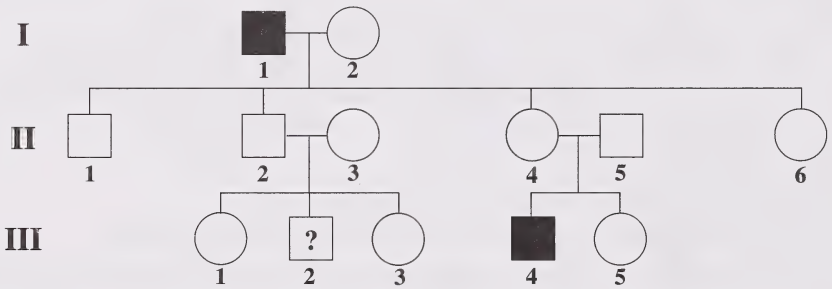
The gene for a light-sensitive protein found in red cones and the gene for a light-sensitive protein found in green cones lie side by side on the X chromosome. A third gene for a light-sensitive protein found in blue cones was discovered on chromosome 7. Mutations to any of these genes result in the common forms of colourblindness. The mutant alleles for these disorders are recessive.

26. A valid assumption based on this information is that

A. all types of colourblindness are sex-influenced
B. males may be carriers for all types of colourblindness
C. only females may be carriers for blue colourblindness
D. blue colourblindness occurs in males and females with equal frequency

Use the following additional information to answer the next question.

Pedigree of Red–Green Colourblindness in Humans



Note: Heterozygous individuals have not been identified. The phenotype of III-2 is unknown.

27. Based on this pedigree,

A. the probability that individual II-4 is a carrier is 50%

B. it is impossible to determine whether individual II-6 is a carrier

C. if individual III-5 is a carrier, all of her female children will have red–green colourblindness

D. if individual II-3 is a carrier, there is a 50% chance that her male child will have red–green colourblindness

Use the following information to answer the next question.

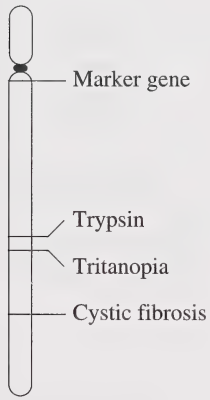
The use of marker genes and the analysis of crossover frequencies of genes have enabled geneticists to map the location of many genes on human chromosomes. Blue colour vision and blue colourblindness (tritanopia) are controlled by a gene on chromosome 7. The gene for the production of trypsin (a digestive enzyme) and the gene responsible for cystic fibrosis are also found on chromosome 7. Some crossover frequencies of these genes are shown below.

Pair of Genes	Crossover Frequency
Marker gene — cystic fibrosis	18%
Marker gene — tritanopia	13%
Cystic fibrosis — trypsin	6%
Trypsin — tritanopia	1%

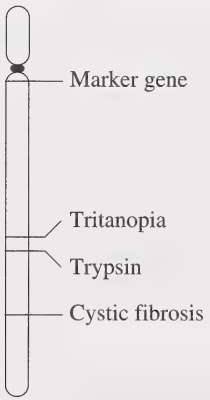
—from *Rimoin et al., 1996*

28. Which of the following gene maps shows the correct sequence of these genes on chromosome 7?

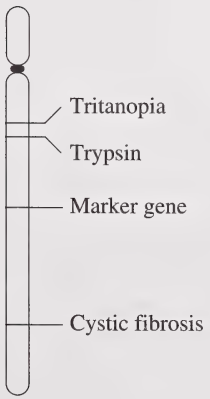
A.



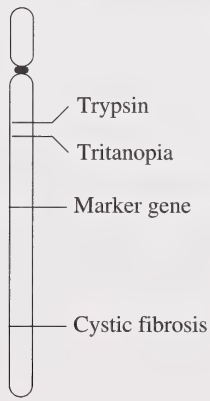
B.



C.



D.



Use the following information to answer the next three questions.

> Cystic fibrosis is the most common genetic disorder among Caucasians, affecting one in 2 000 Caucasian children. The cystic fibrosis allele results in the production of sticky mucus in several structures, including the lungs and exocrine glands. Two parents who are unaffected by the disorder can have a child with the disorder.

29. Which term **best** describes the allele for cystic fibrosis?

A. X-linked
B. Recessive
C. Dominant
D. Codominant

Use the additional information to answer the next two questions.

> A girl and both her parents are unaffected by the disease. However, her sister is affected by cystic fibrosis.

30. The genotypes of the mother and father are

A. both homozygous
B. both heterozygous
C. homozygous and heterozygous, respectively
D. heterozygous and homozygous, respectively

Numerical Response

3. These parents, who are unaffected by cystic fibrosis, are planning to have another child. What is the percentage probability that their next child will be affected by cystic fibrosis?

(Record your **answer as a whole number percentage** in the numerical-response section on the answer sheet.)

Answer: _____%

Use the following information to answer the next question.

> Hypophosphatemia is one of the few genetic diseases caused by a dominant allele carried on the X chromosome. It causes a severe deficiency of phosphate ions in the blood.
>
> —from *Rimoin, et al., 1996*

31. A female with hypophosphatemia whose father had the disease but whose mother did not will likely transmit the disorder to

A. her sons only
B. her sons and her daughters equally
C. all of her daughters but none of her sons
D. all of her daughters and 50% of her sons

---

32. Certain disorders result if an extra chromosome is present in all nucleated cells of the body (trisomy) or if a chromosome is missing from all nucleated cells of the body (monosomy). These disorders arise because of nondisjunction, a malfunction that occurs during

A. DNA replication
B. RNA transcription
C. telophase of mitosis
D. anaphase of meiosis

Use the following information to answer the next question.

Portion of Insulin Protein

Phenylalanine–Valine–Asparagine–Glutamine–Histidine

33. What is the strand of DNA that would code for this portion of insulin?

A. AAG CAA TTA GTT GTA
B. AAA CAA TTC CAC CTA
C. CAC GAG AAC GTA TTC
D. TTC GTA AAC GAG CAC

Use the following information to answer the next two questions.

Marfan syndrome is an autosomal-dominant disorder of humans. Affected individuals tend to be tall and thin. They have defects in the lens of the eye and weak connective tissue around the aorta. Often, affected individuals excel in sports like volleyball or basketball, but it is not uncommon for people with this syndrome to die suddenly.

Numerical Response

4. A man, heterozygous for Marfan syndrome, and a homozygous recessive woman have a child. What is the probability that the child will be affected by Marfan syndrome?

(Record your **answer as a value from 0 to 1, rounded to two decimal places,** in the numerical-response section on the answer sheet.)

Answer: _____

34. Which of the following statements is a valid prediction about the frequency of this disorder in males and females?

A. Males are affected more often than females.
B. Females are affected more often than males.
C. Males and females are affected with equal frequency.
D. An accurate prediction cannot be made because the syndrome occurs randomly.

Use the following information to answer the next two questions.

In pea plants, tall (*T*) is dominant over short (*t*), and round seed (*R*) is dominant over wrinkled seed (*r*). The Punnett square below shows a cross between a heterozygous tall–heterozygous round-seed pea plant and a short–heterozygous round-seed pea plant. Different types of offspring are represented by numbers.

	TR	*Tr*	*tR*	*tr*
tR	**1**	**2**	**3**	**4**
tr	**5**	**6**	**7**	**8**

35. Which two types of offspring are pure breeders for both plant height and seed shape?

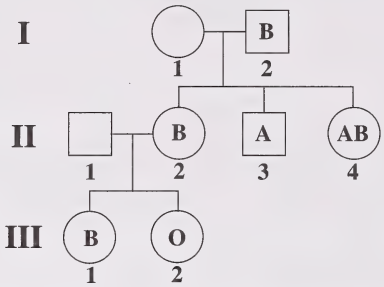
A. 1 and 6
B. 2 and 5
C. 3 and 8
D. 4 and 7

36. Which two types of offspring, when crossed, could be expected to produce a population in which 50% of their offspring would be tall and 100% would produce round seeds?

A. 1 and 8
B. 2 and 4
C. 3 and 7
D. 5 and 6

Use the following information to answer the next question.

Pedigree of Human ABO Blood Types



37. The genotype of individual **I-1** is

A. *ii*
B. I^Ai
C. I^Bi
D. I^AI^A

Use the following information to answer the next question.

In addition to the ABO system, human blood may be typed as Rh^+ or Rh^-. The blood types Rh^+ and Rh^- are controlled by the dominant allele *R* (Rhesus positive) and the recessive allele *r* (Rhesus negative).

Numerical Response

5. If a woman with the genotype $I^AI^B\ Rr$ and a man with the blood type O Rh^- have a child, what is the probability that the child will have blood type A Rh^-?

(Record your **answer as a value from 0 to 1, rounded to two decimal places**, in the numerical-response section on the answer sheet.)

Answer: _____

Use the following information to answer the next two questions.

A variation of leaf markings in white clover is controlled by an autosomal gene (locus). This locus may be occupied by one of several different alleles. The allele V^h produces white lines in long V-shapes on each leaf. The allele V^l produces white lines in short V-shapes, and the allele v produces unlined leaves when homozygous. The order of dominance is $V^h > V^l > v$, and it is assumed that dominance is complete.

A clover plant with long V-shaped lines on the leaves and a clover plant with short V-shaped lines on the leaves produced offspring. Some of the offspring had long V-shaped lines on the leaves, some had short V-shaped lines, and some had unlined leaves.

White Clover Line Patterns

Unlined | Short lines | Long lines

—from *Griffiths, et al., 1993*

38. The genotypes of the parent plant with long V-shaped lines and of the parent plant with short V-shaped lines are, **respectively**,

A. V^hV^l and vv
B. V^hv and V^lv
C. V^hV^l and V^lv
D. V^hv and V^lV^l

Numerical Response

6. What is the probability of these two parent plants producing offspring that have unlined leaves?

(Record your **answer as a number between 0 and 1, rounded to two decimal places**, in the numerical-response section on the answer sheet.)

Answer: _____

39. DNA is structurally different from RNA in that DNA

A. contains uracil and is composed of double strands
B. contains adenine and is composed of single strands
C. contains guanine and is composed of single strands
D. contains thymine and is composed of double strands

40. Analysis of a DNA sample showed that 15% of the nitrogen-base molecules present were adenine molecules. This sample would likely contain

A. 15% thymine
B. 15% uracil
C. 85% thymine
D. 85% uracil

Use the following information to answer the next two questions.

In DNA replication, the two strands of the double helix separate and a new strand forms along each old one. Each new DNA molecule has one old and one new strand.

41. The name of the old DNA strand and the site of DNA replication are identified in row

Row	Name of Old Strand	Site
A.	a template	nucleus
B.	a template	cytoplasm
C.	haploid	nucleus
D.	haploid	cytoplasm

42. The backbone of a DNA molecule and the composition of A, C, T, and G are identified in row

Row	DNA Backbone	A, C, T, and G
A.	phosphate groups	deoxyribose sugars
B.	purines	deoxyribose sugars
C.	pyrimidines	nitrogen-containing bases
D.	sugars and phosphate groups	nitrogen-containing bases

Use the following information to answer the next two questions.

At the global level, the human population growth rate has been changing at a rapid speed.

Estimates of World Population Growth Rates

1750	Population doubling every 100 years
1970	Population doubling every 34 years
1990	Population doubling every 40 years

—from *Luttwak, 1996*

43. The change in world human population growth rate from 1970 to 1990 was probably **most influenced** by

A. food supplies
B. carrying capacity
C. population density
D. birth control measures

44. The rapidly growing human population is endangering populations of K-strategists while favouring *r*-strategists. Examples of K-strategists and *r*-strategists are, respectively,

A. whales and houseflies
B. elephants and spruce trees
C. cockroaches and dandelions
D. mosquitoes and woodpeckers

Use the following information to answer the next five questions.

From 1968 to 1990, the population of snow geese nesting near Churchill, Manitoba, increased from about 2 000 pairs (4 000 individuals) to about 22 500 pairs (45 000 individuals) with a nesting density of around 1 000 nests per square mile. Snow geese winter along the coasts of Texas and Louisiana. Prior to 1960, marshes along these coasts provided the main food sources (reeds, roots, and tubers) for the geese. Destruction of these marshes and increased crop production of rice, corn, and soybeans has occurred since that time. The stubble from these crops and spilled grains are easily obtained food sources for the snow geese. Reduction in hunting and greatly increased food supplies from cultivation near their wintering ground has cut mortality rates of snow geese in half over this period.

The high nesting density of the snow geese has left little foraging or nesting space for other species of birds, and a decline in several duck species and shore birds has been observed. Simultaneously, intensive foraging by the snow geese erodes and dries out patches of Arctic soil, reduces regrowth of grasses and sedges, and greatly increases soil salinity.

—from *Brodie, 1997*

—from *Boissinot, 1997*

Numerical Response

7. Based on the information provided, what is the per capita growth rate of the snow goose population between 1968 and 1990?

(Record your **answer rounded to one decimal place** in the numerical-response section on the answer sheet.)

Answer: _____

45. Prior to 1960, the winter food sources in the marshes controlled the growth of the snow goose population. The available supply of reeds, roots, and tubers in the marshes was

A. an example of a community of climax species
B. an example of a community of pioneer species
C. a density-dependent limiting factor for snow geese
D. a density-independent limiting factor for snow geese

46. Given a further increase in the snow goose population, in the Churchill, Manitoba nesting area

A. interspecific competition will increase because of decreased species diversity

B. interspecific competition will increase and intraspecific competition will decrease

C. intraspecific competition will increase because available food supplies are decreasing

D. intraspecific competition will decrease because fewer snow geese will be able to find nesting sites

47. To preserve the diversity of this ecosystem, the first logical human intervention would be to

A. extend the hunting season and increase collection of snow goose eggs

B. replant or reseed grasses and sedges depleted by snow goose foraging

C. reintroduce the duck species and shore bird species that have disappeared from the coastal marshes

D. prevent soil erosion by introducing plant species adapted to high salinity in order to anchor the top soil

48. Based on the information provided, it would be reasonable to conclude that the snow goose population

A. has increased its biotic potential
B. has a higher mortality than natality rate
C. is in the growth phase and environmental resistance is increasing
D. has reached the carrying capacity of the ecosystem and environmental resistance is decreasing

Use the following information to answer the next question.

Examples of Ecological Relationships

1 Tropical acacia trees are hosts to a particular species of ants. The ants are provided with shelter and nutrients from the trees. The trees are protected from other predatory insects by the ants.

2 The protozoan *Opalina ranarum* lives in the digestive tract of some frogs and obtains nutrients in this way without harming the frog.

3 The protozoan *Plasmodium* is the cause of malaria. *Plasmodium* lives in the bloodstream of humans and reproduces inside red blood cells causing the red blood cells to burst.

Numerical Response

8. Match the ecological relationships, as numbered above, with the types of symbiosis given below.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Ecological Relationship: _____ _____ _____
Type of Symbiosis: **Commensalism** **Mutualism** **Parasitism**

Use the following information to answer the next question.

Sperm count is measured in millions of sperm per millilitre of semen. The normal amount of ejaculate is 3 mL and 30 to 100 million sperm/mL is considered within the normal range. A generation ago, 100 million sperm/mL was considered normal. A male whose sperm concentration falls below 20 million sperm/mL is likely infertile.

While working at the National University Hospital in Copenhagen, Denmark, Niels Skakkebaek prepared a report that combined the results of 61 separate studies of sperm count and quality over the last 50 years. His report was based on data involving a total of 14 947 men from 21 countries, including the United States, Europe, Asia, and Africa. His results showed that the average sperm count had fallen from 113 million sperm/mL in 1940 to 66 million sperm/mL in 1990. French research also showed a decline, on average, from 89 million sperm/mL in 1973 to 60 million sperm/mL in 1992. A Scottish study of 600 men showed a 2% decrease in the average sperm count each year for the past two decades. Skakkebaek also reported that the lowest sperm counts are in younger men and that the proportion of their deformed sperm is steadily rising.

Research on conditions during pregnancy or immediately after birth that could reduce the number of certain cells within the testes, called Sertoli cells, may help explain the reported decline in sperm counts. The number of Sertoli cells that a male possesses establishes an upper limit on sperm production, as these cells nourish immature sperm. The number of Sertoli cells is fixed in the fetal or newborn stage of human development, when the multiplication of these cells is catalysed by FSH. Dr. Richard Sharpe, of the Medical Research Council's Reproductive Biology Unit in Edinburgh, is investigating whether low sperm counts may be related to a reduction in the number of Sertoli cells in males.

Estrogen-mimicking compounds found in the environment inhibit FSH production. People worldwide are exposed to thousands of chemicals, some of which mimic the effects of naturally produced estrogen. These chemicals include aromatic hydrocarbons produced by combustion, PCBs, and DDT.

–from *Nichols, 1996*
Moomaw, 1996
Stainsby, 1996
Raloff, 1994
Lambton, 1993

Written Response – 15%

1. **a.** Write a hypothesis that relates sperm count to estrogen-mimicking compounds in the environment. **(2 marks)**

b. **i.** Draw and label a flow chart that illustrates the production of FSH and its effect on Sertoli cell development in male babies. Include all relevant organs and hormones. **(2 marks)**

ii. On the flow chart you have drawn, indicate the proposed effect of estrogen-mimicking compounds on FSH production and Sertoli cell development. **(1 mark)**

c. At low levels, estrogen-mimicking compounds in the environment appear to be harmful to fetuses but not to adults. Describe a possible reason for the greater sensitivity of fetuses to these compounds. **(1 mark)**

d. **i.** Using the data from the French research, calculate the percentage decrease in sperm count from the original value in 1973 to the value in 1992. (Show all calculations.) **(1 mark)**

ii. Predict a possible effect on French society or the French population if this trend continues. **(1 mark)**

e. Given that only one sperm fertilizes an egg, describe two reasons why a man with a sperm count of less than 20 million sperm/mL is likely infertile. **(2 marks)**

f. The effects of estrogen-mimicking compounds on sperm counts are not well established by scientists.

i. What is one possible question you would need answered before you could decide if there is a cause-and-effect relationship between environmental estrogen-mimicking compounds and lowered sperm counts? **(1 mark)**

ii. How would an answer to this question help you evaluate whether this is a cause-and-effect relationship? **(1 mark)**

Use the following information to answer the next question.

Ataxia telangiectasia (AT) is an autosomal recessive disorder occurring with an estimated frequency of 1 in 40 000 births. The first symptoms of the disease occur around two years of age and are progressive; they consist of a lack of balance and slurred speech. Soon after, tiny red (spider) veins appear in the corners of the eyes (telangiectasis). Older children with AT lose their ability to write, and reading becomes impossible as eye movements become difficult to control. Individuals are eventually confined to a wheelchair. Immune system disorders are common. Intelligence is normal in these individuals. Most individuals with AT die as children; however, some live up to 50 years.

Patients with AT develop blood system cancers 1 000 times more frequently than the general population. Treatment of cancer with conventional dosages of radiation can be fatal to AT patients because they are especially sensitive to radiation, which causes breakage of DNA. Even carriers have a higher incidence of cancer than does the general population.

The defect causing AT has been traced to a mutation on chromosome 11. The protein product of this gene is not expressed appropriately. The exact role of the gene remains a mystery. Normal cells respond to DNA damage by interrupting the cell cycle in interphase before DNA synthesis occurs. This allows for repair of the DNA. Scientists are investigating a link between the AT mutation and this cell repair process.

There is presently no cure for AT, but treatments to alleviate symptoms are currently being developed.

—from *NCBI, 1997*
A-T Children's Project, 1997

Written Response – 15%

2. Write a unified response addressing the following aspects of ataxia telangiectasia (AT).

- **Sketch** a diagram of the human brain and **label** four parts. **Identify** the area of the brain most affected by AT. **Identify** the symptoms of AT that relate to degeneration of this area of the brain, and **explain** how these symptoms indicate that this area of the brain has degenerated.

- **Identify** several environmental causes of DNA damage. **Explain** how interruption of the repair process in AT might lead to cancer.

- **Calculate** the frequency of the AT allele **and** the percentage of the population that are carriers. (Show your work.) **Identify** and **explain** how two societal factors and/or technologies could decrease the incidence of the AT disorder in the population of future generations or alleviate the symptoms of AT in individuals.

Human Brain

References

MC3 Guyton, A.C. and J.E. Hall. 1996. *Textbook of Medical Physiology.* Philadelphia: W.B. Saunders Company.

MC28 MC31 Rimoin, D.L., J.M. Connar, and R.E. Pyeritz. 1996. *Principles and Practice of Human Genetics.* New York: Churchill Livingstone.

MC38 NR6 Griffiths, A.J. et al. 1993. *An Introduction to Genetic Analysis.* New York: W.H. Freeman and Company.

MC43 Luttwak, E.N. 1996. Best of all worlds. *The Times Literary Supplement* March: pp. 3–4.

MC45–48 NR7 Brodie, J. 1997. The tragic comeback of the snow geese. *The Globe and Mail,* 8 March.

WR1 Nichols, M. 1996. The sperm scare. *Maclean's* 109 (14): 50–54.

Moomaw, W.R., review of *Our Stolen Future: Are We Threatening Our Fertility, Intelligence, and Survival? A Scientific Detective Story,* by Theo Colborn, Dianne Dumanoski, and John Peterson. *Chemical and Engineering News* 74 (1 April 1996): 34–35.

Stainsby, M. 1996. Shrinking sperm counts linked to petrochemicals. *The Edmonton Journal,* 1 May.

Raloff, J. 1994. That feminine touch: are men suffering from prenatal or childhood exposures to "hormonal" toxicants? *Science News* 145(4): 56–58.

Lambton, C. 1993. Why has human sperm count declined? *Guardian,* 11 February.

WR2 NCBI. "The Human Gene Map. Ataxia Telangiectasia" http://www.ncbi.nlm.nih.gov/cgi-bin/SCIENCE96/gene?ATM (7 April 1997)

Ataxia-Telangiectasia Children's Project. "Home Page" http://ww2.med.jhu.edu/ataxia (5 Nov. 1997)

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BIOLOGY DATA

Symbols

Symbol	Description
D_p	population density
N	numbers of individuals in a population
A	area, space, or volume occupied by a population
t	time
Δ	change
r	biotic potential OR maximum per capita population growth rate
K	carrying capacity
$\frac{\Delta N}{\Delta t}$	a change in population size during time interval
$>$	greater than, dominant over
$<$	less than, recessive to

Symbol	Description
♂	male
♀	female
n	chromosome number
B, b	alleles; upper case is dominant, lower case is recessive
I^A, I^B, i	alleles, human blood type (ABO)
P	parent generation
F_1, F_2	first, second filial (generation)
p	frequency of dominant allele
q	frequency of recessive allele

Equations

Subject	Equation
Hardy-Weinberg principle	$p^2 + 2pq + q^2 = 1$
Population density	$D_p = \frac{N}{A}$
Change in population size	ΔN = (factors that increase pop.) – (factors that decrease pop.)
Per capita growth rate (time will be determined by the question)	$cgr = \frac{\Delta N}{N}$
Growth rate	$\frac{\Delta N}{\Delta t} = rN$ $\quad$ $\frac{\Delta N}{\Delta t} = rN\frac{(K - N)}{K}$

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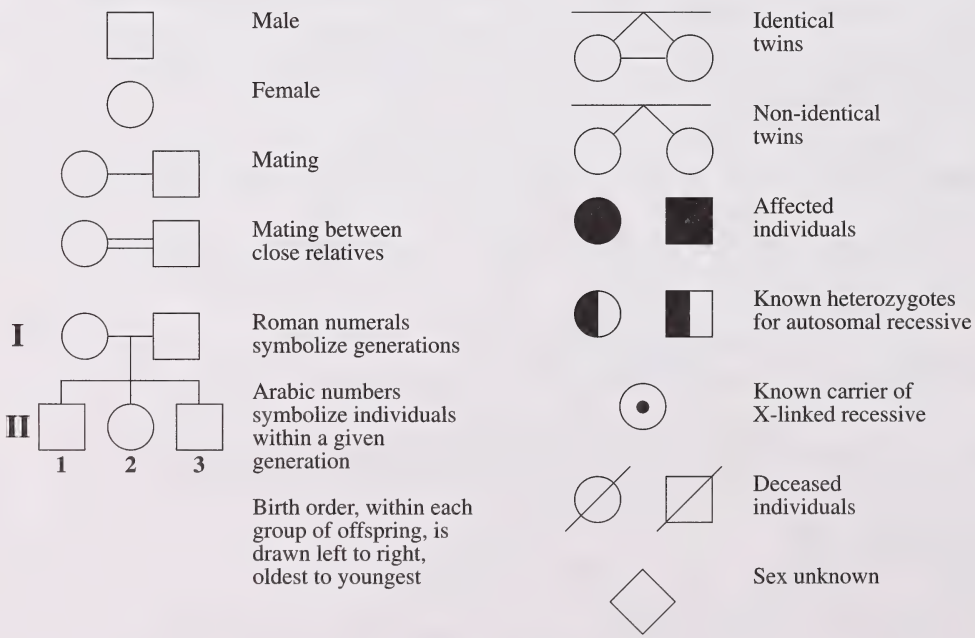
Abbreviations for Some Hormones

Hormone	Abbreviation
Adrenocorticotropin hormone	ACTH
Antidiuretic hormone	ADH
Follicle stimulating hormone	FSH
Human chorionic gonadotropin	HCG
Luteinizing hormone	LH (formerly ICSH in males)
Parathyroid hormone	PTH
Prolactin	PRL
Somatotropin (human growth hormone or growth hormone)	STH (HGH or GH)
Thyroid stimulating hormone	TSH

Pedigree Symbols



Messenger RNA Codons and Their Corresponding Amino Acids

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine	UCU serine	UAU tyrosine	UGU cysteine	U
	UUC phenylalanine	UCC serine	UAC tyrosine	UGC cysteine	C
	UUA leucine	UCA serine	UAA stop **	UGA stop **	A
	UUG leucine	UCG serine	UAG stop **	UGG tryptophan	G
C	CUU leucine	CCU proline	CAU histidine	CGU arginine	U
	CUC leucine	CCC proline	CAC histidine	CGC arginine	C
	CUA leucine	CCA proline	CAA glutamine	CGA arginine	A
	CUG leucine	CCG proline	CAG glutamine	CGG arginine	G
A	AUU isoleucine	ACU threonine	AAU asparagine	AGU serine	U
	AUC isoleucine	ACC threonine	AAC asparagine	AGC serine	C
	AUA isoleucine	ACA threonine	AAA lysine	AGA arginine	A
	AUG methionine	ACG threonine	AAG lysine	AGG arginine	G
G	GUU valine	GCU alanine	GAU aspartate	GGU glycine	U
	GUC valine	GCC alanine	GAC aspartate	GGC glycine	C
	GUA valine	GCA alanine	GAA glutamate	GGA glycine	A
	GUG valine	GCG alanine	GAG glutamate	GGG glycine	G

* Note: AUG is an initiator codon and also codes for the amino acid methionine.

** Note: UAA, UAG, and UGA are terminator codons.

Information About Nitrogen Bases

Nitrogen Base	Classification	Abbreviation
Adenine	Purine	A
Guanine	Purine	G
Cytosine	Pyrimidine	C
Thymine	Pyrimidine	T
Uracil	Pyrimidine	U

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